

Seasonal and diurnal attendance of Kea (*Nestor notabilis*) at Halpin Creek rubbish dump, Arthur's Pass, New Zealand

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ABSTRACT

The diurnal and seasonal attendance of Kea (*Nestor notabilis*) at Halpin Creek dump, Arthur's Pass, from April 1996 to March 1997 was investigated. Many more male (n=56) than female (n=4) Kea were banded at the dump. Resighting data suggested that certain adult male Kea habitually foraged at the dump, whereas younger male Kea probably foraged at the dump until they dispersed from the dump in their second summer. The time individual Kea spent at the dump varied considerably within and between seasons, but did not depend on the individual's age. More Kea were observed at the dump in winter than in summer and they spent more time at the dump in the winter than in summer.

KEY WORDS: Kea, *Nestor notabilis*, refuse, foraging, sex and age differences.

INTRODUCTION

Kea (*Nestor notabilis*, Gould 1856) are an omnivorous mountain parrot, but it is thought that its 'natural' diet consists mostly of plant material (Brejaart 1988). As they are highly mobile, opportunistic feeders Kea are readily able to locate, assess and exploit many food sources (Brejaart 1994). Thus, to Kea, rubbish dumps can be rewarding foraging sites. Worldwide, there are many examples of birds foraging at rubbish dumps (see Isenmann *et al.* 1990, Pons & Migot 1995, Caccamise *et al.* 1997). The size and age composition of such feeding aggregations often varies diurnally and seasonally in response to breeding season (Belant *et al.* 1995), weather, and food availability (Monaghan *et al.* 1986). In Australasia, however, there has been little research on animals foraging at rubbish dumps

Bond & Diamond (1992) studied Kea at Halpin Creek dump. They estimated that the population of Kea in the dump area was between 88 and 119 and used this as a basis to estimate the population of Kea in the Bealey Valley. Bond & Diamond (1992) suggested that Kea were attracted to the dump from a 3-4 km radius, but other observations suggested that Kea may travel greater distances to the dump (Brejaart 1994). Bond & Diamond's (1992) research was restricted to summer. Thus, it is not known whether the number or age composition of Kea visiting the dump fluctuates during the year. Nor is it known how much time the 'average' Kea spends at the dump and whether this varies seasonally or is age dependent.

This paper is part of an investigation into the hazards Kea face when foraging at rubbish dumps (Jarrett 1998). It investigates Kea attendance at Halpin Creek

dump throughout the year. Ascertaining how much time Kea spend at the dump may be a useful tool in quantifying the hazards dumps pose to Kea. By quantifying these it may be possible to establish if foraging at rubbish dumps is detrimental to the well-being of kea populations. Our primary objectives were:

1. to investigate seasonal and diurnal patterns of Kea attendance at Halpin Creek dump, Arthur's Pass
2. to investigate whether the time spent at the dump was age or sex related.

METHODS

Study Site

This research was carried out at Halpin Creek dump, Arthur's Pass Village, between April 1996 and March 1997. Halpin Creek dump (42°58'S 171°35'E), now closed, was a trench style landfill in the Bealey Valley, 700 m above sea level. It was sited on an alluvial outwash fan on the valley floor at the confluence of Halpin Creek and Bealey River, 3.2 km south of Arthur's Pass Village (Department of Survey and Land Information Infomap 260-K33). The dump was triangular and covered about 1 ha. A trench approximately 20 m long, 5 m wide and between 3 and 4 m deep was dug. When nearly full of rubbish the trench was covered with material from a newly dug trench. According to Jackson (1962) Kea have foraged there since 1956 and possibly longer. The dump was closed in November 1997 (D. Hock pers. comm.) because it was near the end of its lifespan and was perceived to have a negative impact on Arthur's Pass National Park (Department of Conservation 1995). All rubbish from the Arthur's Pass area is now transferred to an alternative site near Darfield (D. Hock pers. comm.)

Capturing and banding

Two sessions, each of two consecutive days, in autumn and early winter 1996, were spent capturing Kea with a manually operated drop net or a hand held snare. The captives were placed in a wire cage (620 x 320 x 350 mm) and transported to a Department of Conservation facility at Arthur's Pass village. Here the birds were weighed to the nearest 25 g (using a Slater 5 kg spring balance) and their culmen length, culmen width and tarsometatarsus length were measured to the nearest 0.2mm (using a Vernier calliper) following methods used by Bond *et al.* (1991). After being handled, the Kea were fed with pieces of carrot and apple before being returned to the dump and released within 4 h of capture. To allow identification of individual Kea, 6 mm and 12 mm plastic colour bands were used in combination with individually numbered 12 mm alloy bands ('L' size). These bands were supplied by the Banding Office, Department of Conservation, Wellington.

Identifying age and sex

After capture Kea were aged using the colouration of their bill, cere and eye ring and sexed using bill measurements (Bond *et al.* 1991, Brejaart 1994). In this

study, Kea were placed in four age classes: (i) <1 year, (ii) one year old, (iii) immature (2-3 years old) and (iv) adults (4 years +). Kea in classes (i) and (ii) are collectively called 'younger Kea' and those in classes (iii) and (iv) are collectively called 'older Kea'.

Counting and timing

At sites occupied by humans, Kea are active from first light until after dark (Jackson 1963, Brejaart 1994), but tend to reduce their activity between mid morning and mid afternoon (Brejaart 1994). The sampling year, April 1996-March 1997 was divided into four seasons: autumn: March-May; winter: June-August; spring: September-November; summer: December-February. During each season, two sessions, each of three consecutive days, were spent keeping a tally of the number of Kea foraging at the dump during daylight. Observations were made from the side of the trench using 7 x 35 binoculars. Each time a Kea arrived or departed from the dump the tally was updated. Every 30 minutes, or after a group of Kea arrived or departed from the dump, a total count was made to confirm that the running tally was correct. Kea in the forest next to the dump and those flying overhead were not included. Morning observations started 1 h before sunrise and concluded one hour after the last Kea left the dump in the morning. Thereafter, every 90 minutes a count was undertaken and any banded Kea present were identified; this continued until the afternoon observation period began. The afternoon observation period began 4 h before sunset and finished 1 h after sunset. Sunrise and sunset times were established by using tables published by the Ministry of Transport (1996, 1997); all times were converted to New Zealand Standard Time. The arrival and departure times of colour banded Kea were recorded. This allowed calculation of the total time that these Kea spent at Halpin Creek dump each season, the number of visits they made and the length of each visit. Kruskal-Wallis tests were used to test this data for significance. It was not known if Kea roosted or foraged at the dump through the night. To test for this the Spearman-Rank Correlation Coefficient between banded Kea that were present at the dump 45 minutes after sunset and present 45 minutes before sunrise the following day was carried out.

Frequent, unpredictable events (e.g., heavy trucks and trains passing the dump, vehicles visiting the dump, flammable and pressurised containers exploding when the dump was burning, and New Zealand Falcons [*Falco novaeseelandiae*] passing overhead) resulted in most Kea seeking shelter in the surrounding forest. Kea usually returned to the dump within 5 to 10 minutes. These disturbances would have resulted in instantaneous counts not being truly representative of the number of Kea present at the dump. To compensate for these sudden fluctuations in Kea numbers a weighted moving average (Sokal and Rohlf 1981) of the mean number of Kea present at each 10 minute count period (t) was calculated as:

TABLE 2 – Time in minutes that adult male kea banded before 1992 spent at halpin Creek dump each season during this study 1996/97.

Band number	Date banded	Banding location	Autumn	Winter	Spring	Summer
L-14801	28/11/86	Craigieburn Forest	-	91	67	-
L-15061	23/10/88	Coach Road	103	127	107	57
L-2-189	20/11/88	Halpin Creek dump	127	538	381	112
L-202-- ¹			495	740	183	384
L-20227	8/1/90	Halpin Creek dump	-	308	223	-
L-21491	31/8/92	Arthur's Pass Village	-	-	47	-

¹Only the first three digits of the metal band could be read. The other two digits were between 01-07. Kea with these combinations were banded at Arthur's Pass Village, Edward's Hut or Halpin Creek dump between June and August 1989. However, owing to its colouration, injured feet, method of moving about on the ground and behaviour it was instantly recognisable.

Within each season there was no variation in the amount of time that the different age cohorts spent at the dump (Kruskal-Wallis all $P > 0.2$). Except for immature Kea, all age cohorts of Kea spent the greatest amount of time at the dump in the winter and the least amount of time in the summer (Figure 3).

One adult male Kea banded in 1989 (L-202—) spent significantly more time at the dump than the 'average' Kea over the whole year. On a seasonal basis, it spent significantly more time at the dump than the 'average' Kea in autumn and winter. L-20272, an immature Kea that was banded during this study, spent significantly more time at the dump than the 'average' Kea in spring.

The mean length of each visit to the dump did not vary significantly between seasons (Kruskal-Wallis $p > 0.8$). However, a significant relationship existed between the number of days that Kea were observed at the dump in different seasons (Kruskal-Wallis $P < 0.05$). In winter Kea visited the dump on significantly more days than in summer (Mann-Whitney $P < 0.05$). The highest morning count of Kea was 25 and highest evening count was 35; both these counts occurred in winter.

Kea were present at the dump at night. However, because torch light disturbed the Kea and the colour bands could not be seen with the night vision scope it was not possible to count them accurately, nor identify which individuals were present. Locating Kea with the night vision scope was also difficult. A significant correlation existed between the banded Kea that were present at the dump 45 minutes after sunset and present 45 minutes before sunrise the following day (Spearman-Rank $r_s = .657$, $P < 0.05$). Between 73 and 100% of banded Kea present at the start of the morning observation periods had been present at the end of the previous afternoon observation period.

The time before sunset that Kea began to arrive at the dump was consistent in all seasons except winter. Except for summer the time that Kea scattered from the dump after sunrise was consistent (Figure 4). Poor weather appeared to influence Kea numbers and the time before sunset that they arrived at the dump (Figure 5).

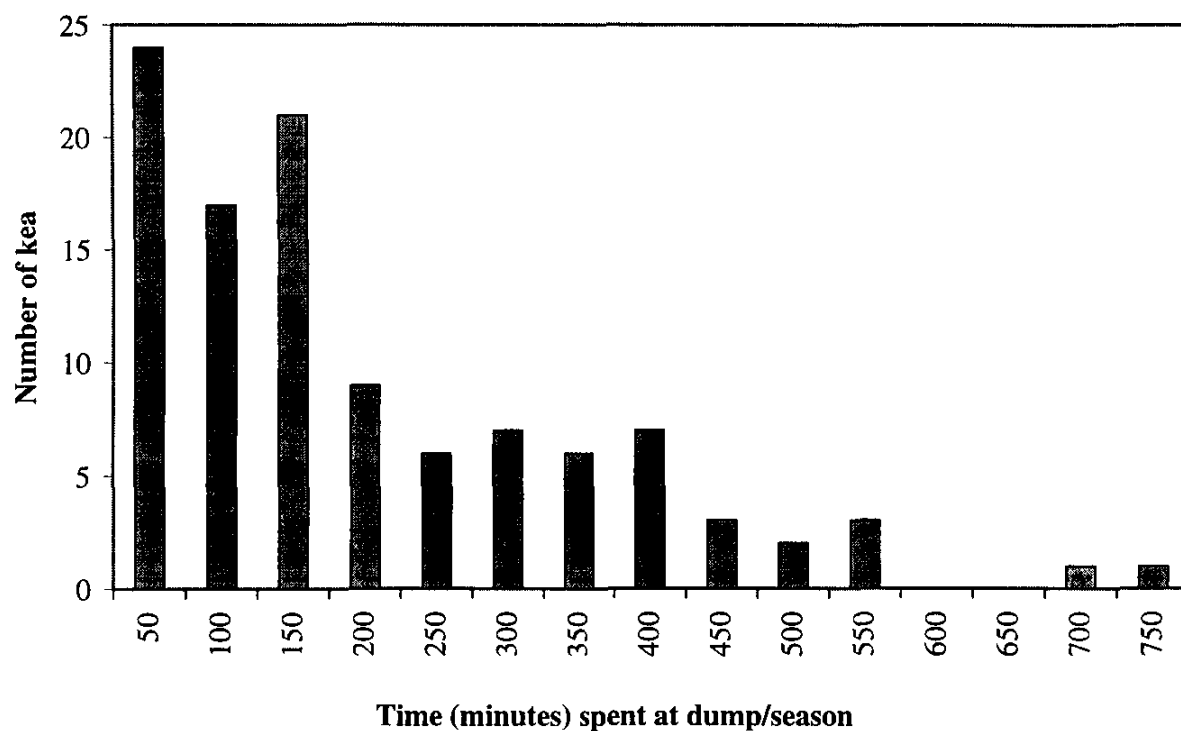


FIGURE 2 – The number of Kea and the cumulative time (minutes) banded Kea spent at Halpin Creek dump in a season.

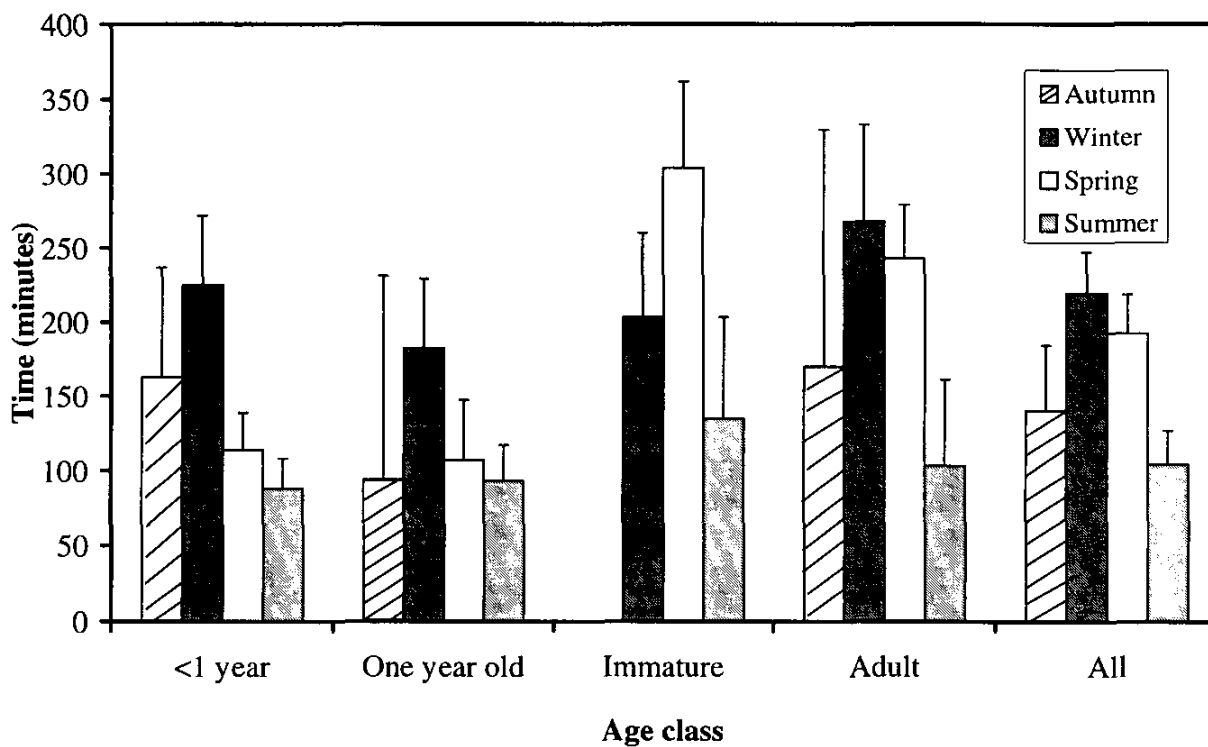
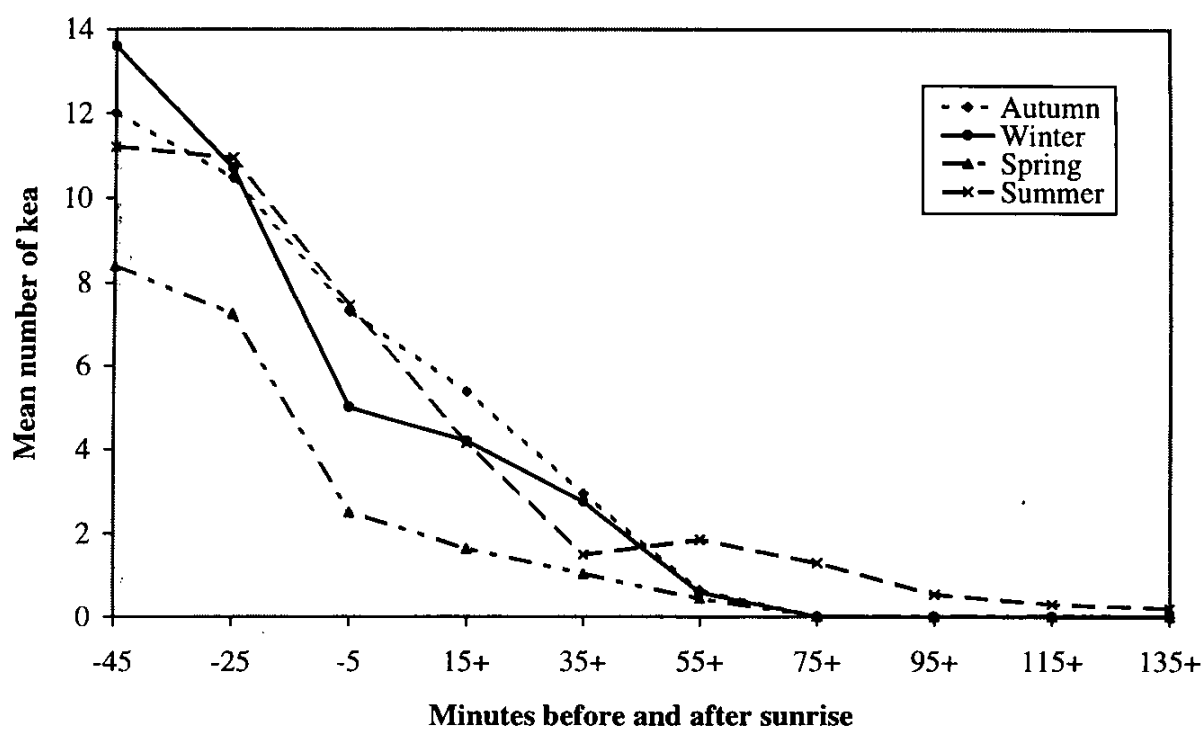


FIGURE 3 – Relationship between kea age class and time spent at Halpin Creek dump each season (\bar{x} and S.E.). During autumn, seven immature kea were banded. One was observed on non-banding days and this kea spent 276 minutes foraging at the dump.

4a



4b

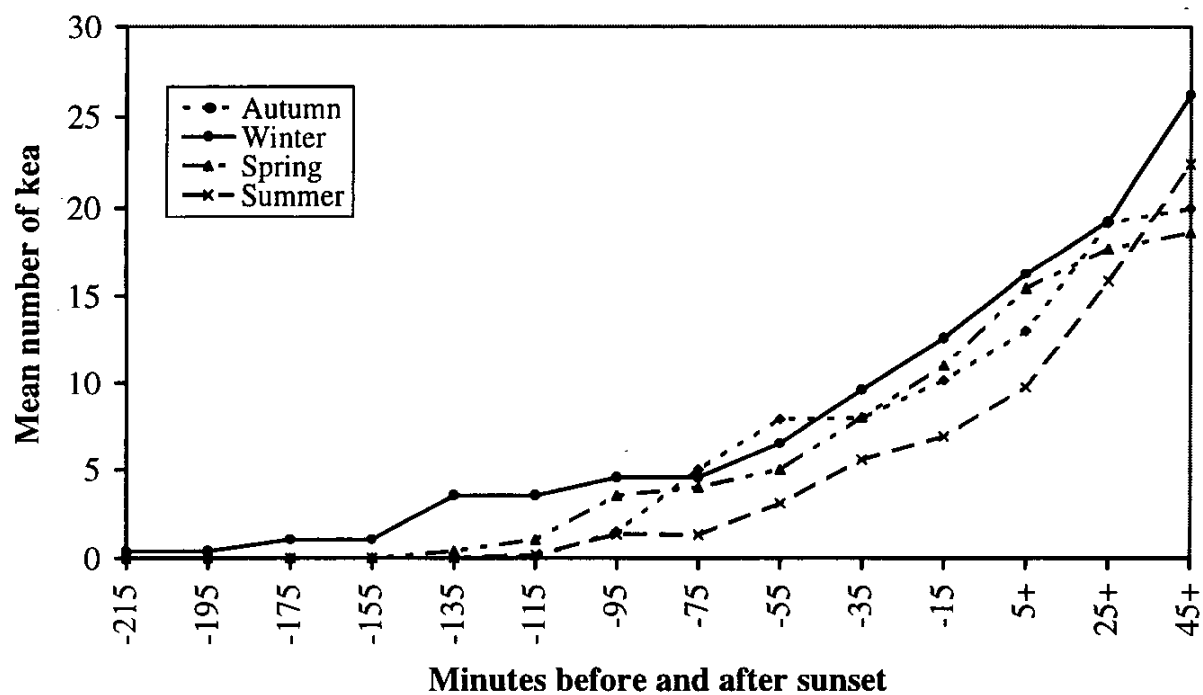


FIGURE 4 – Mean number of kea observed (a) before and after sunrise and (b) before and after sunset in each season at Halpin Creek dump.

DISCUSSION

In this study 14 times more male Kea were banded than females. However, the sex ratio of most species of animals is equal (Krebs & Davies 1997) and a near equal ratio of male to female Kea occurs in areas away from sites of human occupation (Department of Conservation unpublished data, K-J Wilson pers. obs.). Few female Kea have been seen by other researchers at Halpin Creek dump (Bond and Diamond 1992) or at Arthur's Pass Village (Brejaart 1994). No adult female Kea have been banded at Halpin Creek dump (K-J Wilson unpublished data, Department of Conservation unpublished data). Thus, rubbish dumps appear to be of less importance to foraging females than they are to males. However, during nesting, male Kea collect food for their mates and young (Wilson and Brejaart 1992). The extent to which males provision females and their young during breeding, nesting and fledging is unknown as it was not possible to identify which male Kea using Halpin Creek dump were breeding.

Kea were banded during autumn and winter. Over time, the number of banded Kea that were re-sighted decreased, particularly in the case of younger birds. The lower rate of re-sighting of younger Kea may have been due to their dispersal (Bond & Diamond 1992) or high winter mortality (Jackson 1969). It has been suggested that, during their second year, male Kea disperse from the Arthur's Pass area (Bond and Diamond 1992), usually during spring (Jackson 1960, Clarke 1970). However, it is unclear if Bond and Diamond (1992) meant dispersal from the natal territory or from Halpin Creek dump. If the decline in the number of younger Kea re-sighted was due to mortality, it would be expected that the decline would be most evident in winter, rather than in spring or summer. As 80% ($n=28$) of younger Kea banded in autumn or winter were observed in spring or summer it is probable that dispersal from the dump area rather than winter mortality contributed to the decline in re-sightings.

Casual observations suggested that some Kea disperse from the dump during late winter or early spring. L-20274, a one year old, was frequently observed at the dump until mid winter 1996. Later, it was seen at Goat Pass Hut (6.8 km from the dump) every day for a week in mid January, 1997 (M. Jarrett pers. obs.). L-20265, another one year old, was observed at Halpin Creek dump until mid August, 1996 and then 10 km away at Otira dump in late October, 1996 (M. Jarrett pers. obs.). A larger percentage of older Kea were observed during all seasons following their banding than younger Kea. This suggested that adult male Kea may live permanently near the dump, whereas most younger Kea stayed only until they dispersed. This result agreed with Bond & Diamond (1992) who found that younger Kea were rarely seen at Halpin Creek dump in years after their banding, whereas many of the adult males were seen across the years. From late December 1997 an influx of Kea that were <1 year old occurred.

Within and between each season there was no statistically significant variation in the amount of time that the different age classes of Kea spent at the dump, due in part to the huge variation in the amount of time individual Kea spent at the dump. For example, in winter, the mean amount of time that adult male Kea spent

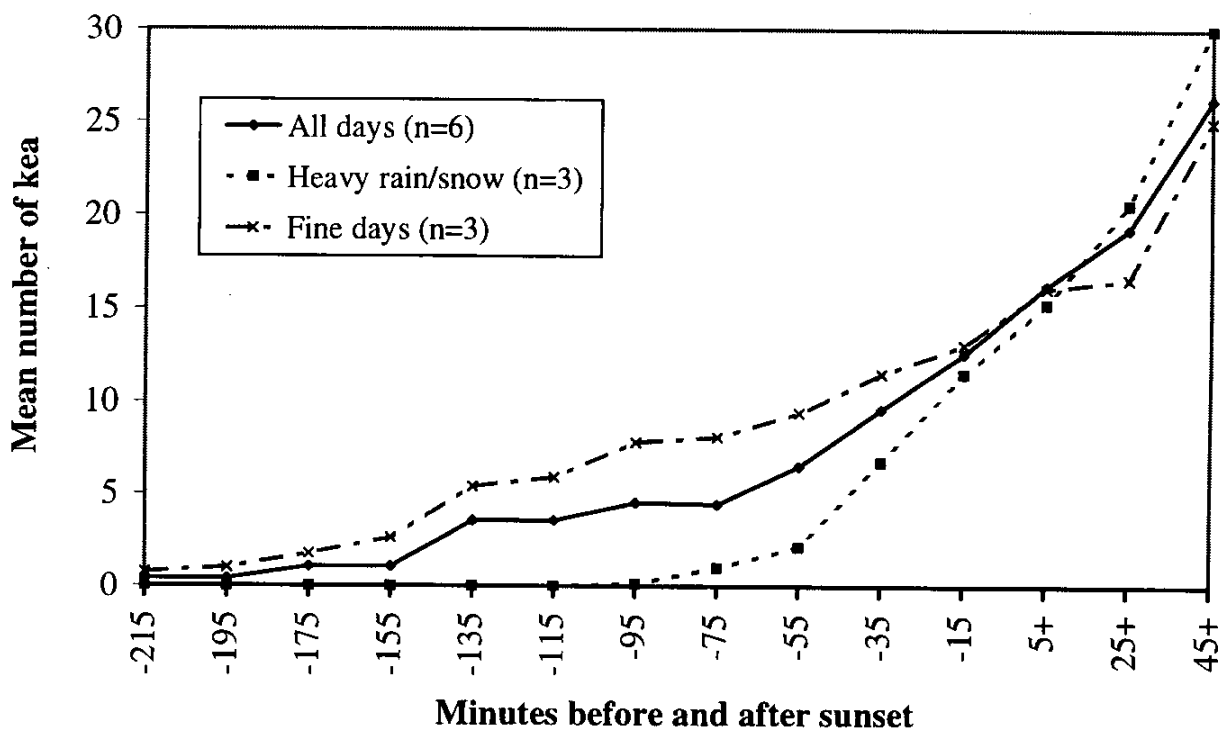
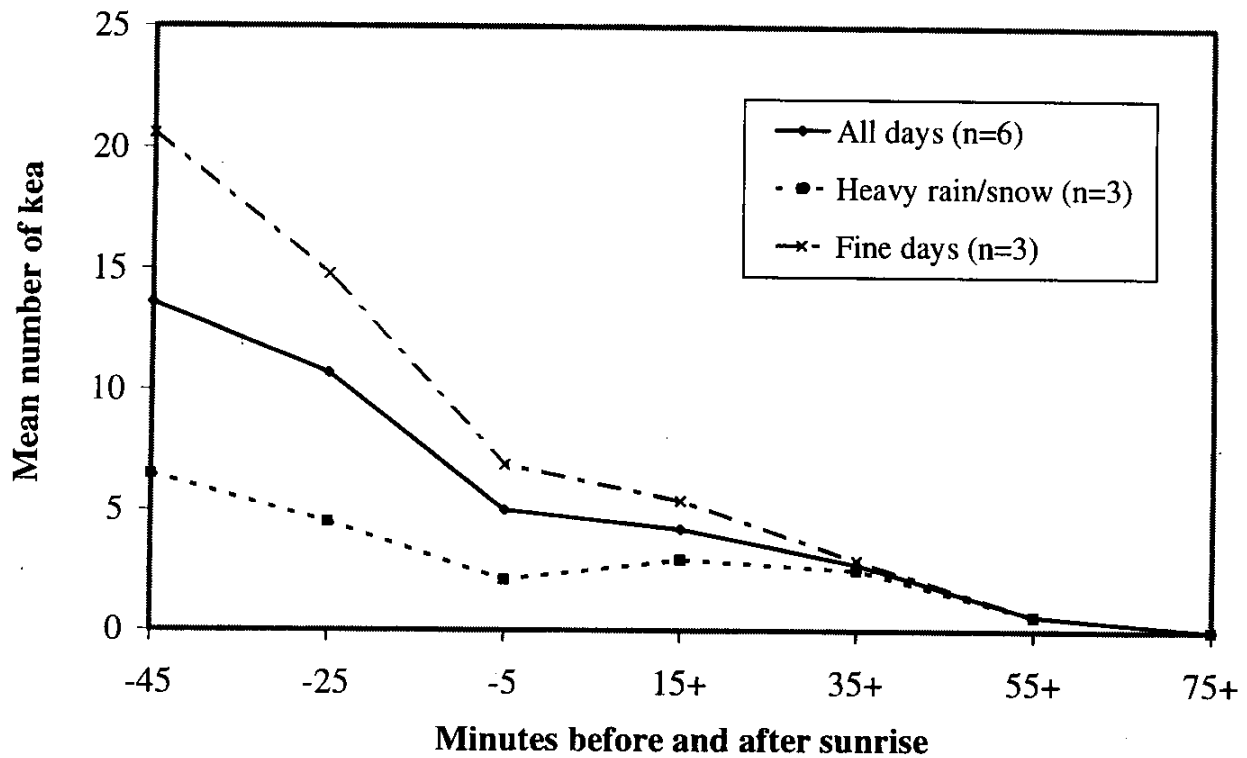


FIGURE 5a – Effect of poor weather on the number of kea present in the morning and afternoon during winter at Halpin Creek dump.

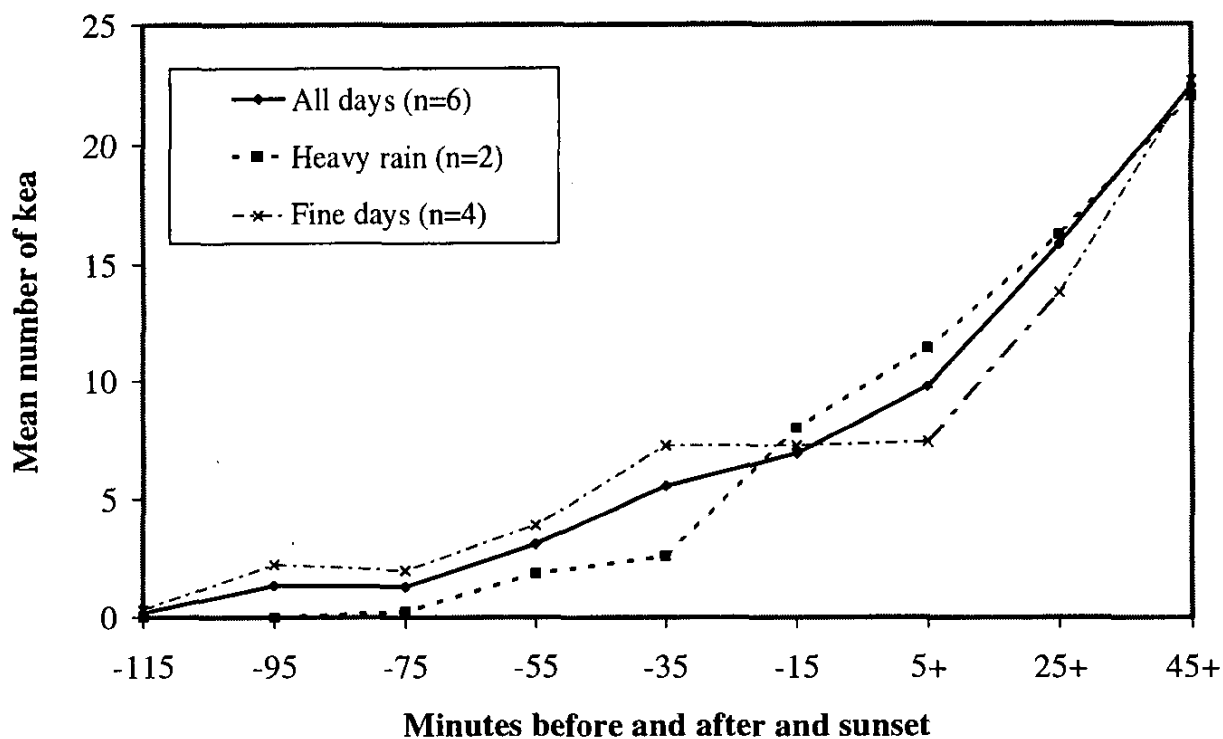
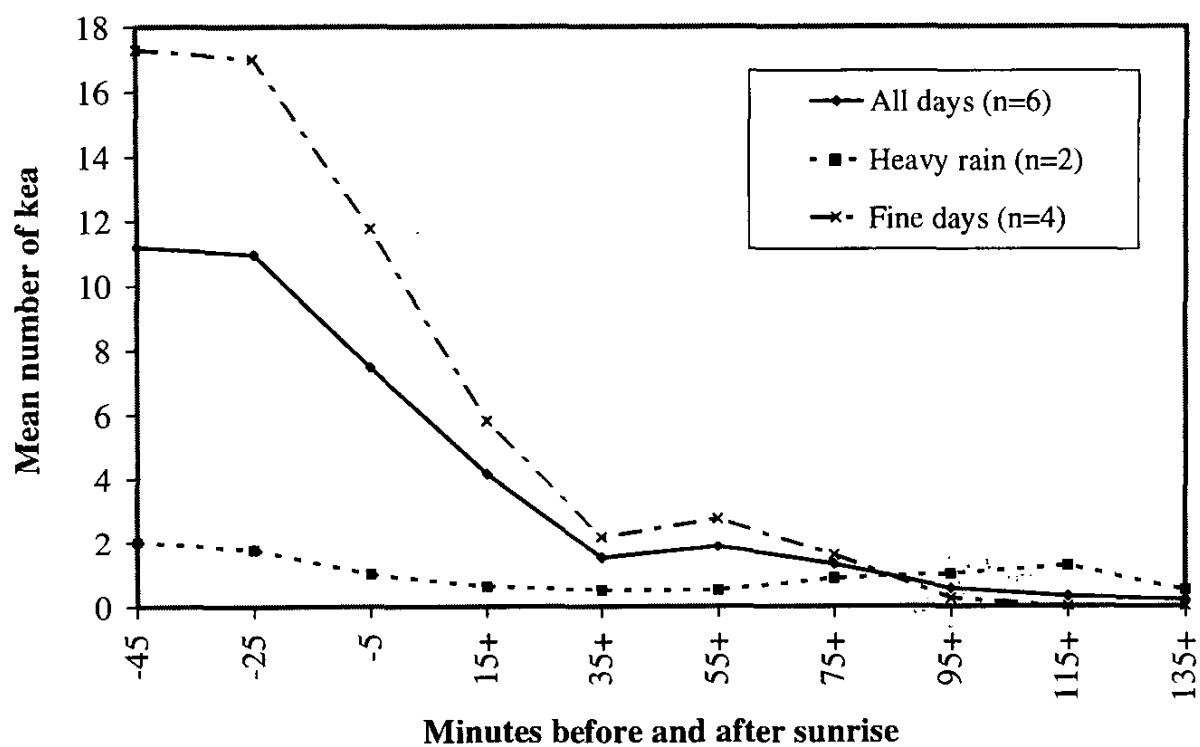


FIGURE 5b – Effect of poor weather on the number of kea present in the morning and in the afternoon during summer at Halpin Creek dump.

at the dump was 232 ± 36 minutes (\bar{x} and S.E.), but L-20255 was observed for 10 minutes and L-20189 for 538 minutes. L-20263, a <1 year old Kea, spent 359 minutes at the dump in the autumn (164 ± 42) and 20 minutes in the winter (230 ± 49). During all seasons except spring L-202—, an adult male Kea that was banded in 1989, spent more time at the dump than any other Kea. In autumn and winter this time was significantly greater than the 'average' Kea. In spring L-20272, an immature Kea, spent significantly more time at the dump than the 'average' Kea. Thus, a few Kea spent unusual amounts of time at the dump. The amount of time an individual Kea spent at the dump varied considerably between the seasons and the variation in time that different individuals from the same age class spent at the dump in the same season also varied considerably. Therefore, the importance of the dump for foraging appears to vary enormously between individual Kea.

More Kea were present at the dump in winter than in any other season and fewest in summer. However, this difference was not statistically significant. Some adult males were observed at the dump only during winter and early spring. This and the dispersal of younger Kea may have caused the decline in numbers of Kea at the dump during late spring and summer. Kea spent more time at the dump in the winter than in summer and arrived at the dump, in winter, sooner before sunset than in any other season. It was the only time of year when Kea were present at the dump all day. This was the only season during which all but one of the banded adult Kea were recorded at the dump. L-21491, an adult male Kea banded in Arthur's Pass Village in 1992, was the only banded adult Kea observed both in Arthur's Pass Village and at the dump during this study. It visited the dump six times on two consecutive days during early spring. It was suggested that L-21491 may have been breeding (S. Phillipson pers. comm.). During winter the greater numbers of Kea at the dump may reflect winter food shortage (Campbell 1976, Brejaart 1994) and foraging at the dump may enhance their chances of surviving harsh winters. Thus, the importance of the dump for foraging not only varies between individual Kea, but also at different times of the year.

Except in summer, Kea scattered from the dump within 75 minutes of sunrise. In all seasons except winter, Kea started arriving at the dump between 155 and 115 minutes before sunset. Most summer mornings, three fledgling Kea remained at the dump well after sunrise. The presence of the observer may have influenced the behaviour of these Kea because they often approached the observer. They appeared to spend most of this time 'playing' with rubbish and each other.

Heavy rain, strong winds and snow flurries may influence Kea movements (Jackson 1960, Clarke 1970, Campbell 1976), although Brejaart (1994) did not find any correlation between the weather and the number of Kea present at Arthur's Pass Village or the Craigieburn Valley during the winter. This may have been because that winter was mild (Brejaart 1994). In this study the weather influenced the number of Kea at the dump. On mornings with heavy rain or snow there were fewer Kea at the dump. In the winter when it was raining heavily or snowing, Kea started to arrive at the dump later in the afternoon, but by the end of the day more

Kea were present than on other days. It is possible that for short periods Kea delayed foraging, but if the poor weather continued then hunger may have forced them to forage.

Only on one day were Kea ($n=3-4$) observed at the dump all day - a Saturday during the winter. This was also the day most Kea were observed at the dump. That day the weather had become fine after four days of heavy rain, snow flurries and strong, gusty winds. Throughout the study it was noticed that soon after people dumped rubbish some Kea arrived at the dump from the nearby forest, whereas before the vehicles arrived no Kea were present. This observation was not surprising as Brejaart (1994) found that the number of people present and the availability of anthropogenic food influenced the number of Kea present in Arthur's Pass Village. Studies on Herring gulls (*Larus argentatus*) have found that their numbers and time of arrival at rubbish dumps were related to the arrival of rubbish deliveries and the amount of available food (Monaghan *et al.* 1986). During winter, local ski-field operators dumped their rubbish at Halpin Creek dump on Saturdays (M. Jarrett pers. obs.). Perhaps both the weather and dumping of rubbish influenced the large numbers of Kea present on that day.

Often, the same banded Kea were seen at the dump at the end of the afternoon observation period and at the beginning of the following morning's observation period. During the night, some Kea were observed foraging at the dump or resting in trees near the dump. It was not possible to identify individuals with the night vision scope, but these observations suggest that some Kea forage at the dump before roosting for the night and again before scattering for the day.

In conclusion, it appeared that some adult male Kea habitually foraged at the dump, few female Kea foraged at the dump and younger male Kea probably foraged at the dump until they dispersed from the dump area in their second summer. This may mean that, in the long term, the dump had a greater impact on certain adult males than on most adult males or any younger or female Kea. However, the provisioning of female Kea by their mates foraging at rubbish dumps during breeding and the effect of rubbish dumps on survival and reproduction needs further investigation. There was a huge variation in the amount of time that individual Kea spent at the dump and more Kea foraged at the dump in winter than summer. Thus, the importance of the dump to foraging Kea probably varies between individuals, but also seasonally. Consequently, the body condition of Kea and the hazards that dumps pose may vary considerably between individuals and this may relate to the amount of time that individual Kea spend at the dump.

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